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EXAMINER

MUTSCHLER, BRIAN L

ART UNIT PAPER NUMBER

1753

DATE MAILED: 10/08/2003

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/855,059

Applicant(s)

BASOL ET AL.

Examiner

Brian L. Mutschler

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-- The MAILING DATE of this communication appears on the cover sheet with the corresponding address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 27 August 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-9, 12-45, 57-61 and 63-74 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 3 and 26 is/are allowed.
- 6) ☒ Claim(s) 1, 2, 4-9, 12-25, 27-45, 57-61 and 63-74 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on August 27, 2003, has been entered.

Comments

2. Applicant's cancellation of claims 10 and 11 in Paper No. 19 submitted August 27, 2003, is acknowledged.

3. The rejection of claims 1 and 4-6 under 35 U.S.C. § 102(b) over Galik has been overcome by Applicant's amendment. Galik teaches a mask formed on the surface of the substrate, which is incapable of moving relative to the substrate during processing, as recited in amended claim 1.

4. The rejection of claims 7-11, 19 and 64 under 35 U.S.C. § 102(b) over Geels has been overcome by Applicant's amendment. Geels teaches that the conductive screens 35, 35' are unconnected. Connecting the screens would proceed against the teachings of Geels. Therefore, even though the limitation "configured to connect to a power source" is not a positive limitation requiring a connection between the conductive

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element and the power source, since Geels teaches that the screens are unconnected, the screens would not be configured to connect to a power source.

5. The rejection of claims 1, 4-9, 12, 19-25, 27, 32-45 and 57-61 under 35 U.S.C. § 103 over Stone in view of Edelstein have been modified to address the amendments presented by Applicant and to state the Examiner's position more clearly using Jorne et al. (U.S. Pat. No. 6,132,587) as additional evidence of Examiner's position.

6. The indication of claim 13 as allowable has been withdrawn in light of Applicant's amendment, which raise new issues that are addressed below.

Claim Rejections - 35 USC § 112

7. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

8. Claim 74 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claim 74 was added to include "electropolishing" as a possible method of processing. The disclosure provides support for electroetching, but does not disclose that the apparatus can be used for electropolishing. Electroetching and electropolishing are closely related but there are

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differences between the two processes. Electroetching pertains more to a method for removing material, while electropolishing is used to achieve a desired surface uniformity. The processes generally use different current densities and often use different apparatuses as well. It is suggested that claim 74 be amended to replace "electropolishing" with --electroetching--.

9. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

10. Claims 13, 67 and 69 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim 13 recites the preamble "An anode assembly" in line 1. However, the claim does not recite an anode. An electrode is disclosed, but the electrode could be either an anode or a cathode, depending on how it is used. It is suggested that the claim be amended to recite an anode to restore agreement between the preamble and the claim limitations.

Claim 67 recites the limitation "the another electrode is in the mask" in line 1. This limitation is indefinite because there is insufficient antecedent basis for "the another electrode." The limitation is also indefinite because it is unclear what the relationship is between the "another electrode" and the mask.

Claim 69 recites the limitation "the conductive mesh comprises areas" in line 1. This limitation is indefinite because it does not further limit the conductive mesh. It is

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suggested that the phrase be changed to --the conductive mesh comprises a plurality of separate areas-- or be changed to include the limitations of claim 70 to clearly define the areas as being distinct from one another.

Claim Objections

11. Claims 1, 14, 71 and 72 are objected to because of the following informalities:

- a. In claim 1 at line 7, please change "is configured" to --are configured--.
- b. In claim 14 at line 2, please change "facing" to --faces--.
- c. In claim 71 at line 2, please insert --source-- after "power".
- d. In claim 72 at line 2, please insert --source-- after "power".

Appropriate correction is required.

Claim Rejections - 35 USC § 102

12. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

13. Claims 7-9, 12, 14 and 19 are rejected under 35 U.S.C. 102(b) as being anticipated by Galik (U.S. Pat. No. 4,678,545).

Regarding claim 7, Galik discloses an apparatus for electroplating a circuit board comprising anodes **44** contacting the electrolyte **36** (fig. 8). The circuit board has a mask (nonconductive layer) with a plurality of openings defining the areas to be plated

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(col. 2, lines 23-49). The mask has a first surface facing the anode **44** and a second surface contacting the substrate. Conductive mesh screens **46** are positioned between the anodes **44** and mask that is attached to the wafer **32** (fig. 8; col. 5, lines 35-44). The screens **46** are connected to a power source (fig. 8).

Regarding claim 9, the conductive mesh screens **46** are shown having two areas electrically isolated from one another (fig. 8).

Regarding claim 12, the power to each screen **46** is separately regulated and variable (fig. 8; col. 6, lines 18-52).

Regarding claim 8, the conductive element is a conductive mesh screen **46** (col. 5, lines 35-44).

Regarding claim 14, the screens **46** are positioned between the anodes **44** and the wafer **32** (fig. 8).

Regarding claim 19, the screens **46** are in the shape of strips (fig. 6; col. 5, lines 35-44).

Since Galik teaches the limitations recited in the instant claims, the reference is deemed to be anticipatory.

Claim Rejections - 35 USC § 103

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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15. Claims 1, 4-9, 12, 19-25, 27, 32-45, 57-61 and 68-74 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stone (U.S. Pat. No. 6,132,583) in view of Edelstein (U.S. Pat. No. 6,106,687) and in view of Jorne et al. (U.S. Pat. No. 6,132,587).

Regarding claims 1, 7, 8, 20, 21, 27, 57, 58 and 73, Stone discloses an apparatus for plating wafers comprising a plurality of anodes **22A**, **22B** contacting the electrolyte **21** (fig. 2). Between the wafer **26** and the anodes **22A**, **22B**, shields are disposed (fig. 2). In one embodiment, the shield is a conductive mesh **40** connected to a power supply in such a way that the output is variable (fig. 2; col. 6, lines 35-62). The cathode assembly **26** is movable (col. 5, lines 23-27). The charged screens **40** act to control the flow of ions in the solution (col. 6, lines 1-5). By controlling the flow of ions, the concentration of the solution contacting the substrate is controlled. Stone also teaches that the substrate cathode **26** is movable between the anodes **22A**, **22B** (col. 5, lines 29-41).

Regarding claims 4, 9, 22, 59 and 68-72, Stone teaches that the two shields may be any of the disclosed shields, such as two of the conductive mesh shields (col. 5, lines 61-65). Furthermore, separately controllable screens **40** may be disposed on either side of the cathode **26**, as shown in Figure 2. In Figure 2, the top screen **40** is shown allowing the ions to flow through, while the lower screen **40** is repelling the ions.

Regarding claims 5, 6, 12, 25, 33, 36, 39, 40 and 43, each screen **40** is charged with a voltage by a voltage source (col. 6, lines 45-54). According to Stone, "the applied

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voltage magnitude is variable...and the power may be provided from any voltage source" (col. 6, lines 55-62):

Regarding claims 23 and 60, the frames **52** containing the charged screens **40** are attached to a glide bar **32** (col. 6, lines 35-44). Since only the screens **40** are charged, it would be inherent that either the frame **52** or other supporting member would be electrically isolating.

Regarding claims 24 and 61, two charged screens **40** are separated by a gap (fig. 2).

Regarding claims 19 and 32, the screens **40** have the form of strips (fig. 5).

Regarding claims 34, 35, 37, 38, 41, 42, 44 and 45, Stone discloses that the charged screens **40** can either accelerate or decelerate the flow of ions (col. 7, lines 7-26).

The plating apparatus disclosed by Stone differs from the instant invention because Stone does not disclose the following:

- a. A mask with openings, as recited in claims 1, 7, 20 and 57; and
- b. The power sources and additional power sources, as recited in claims 5, 6, 12, 25, 33, 36, 39, 40 and 43.

Regarding claims 1, 7, 20 and 57, Jorne et al. teach an apparatus for electroplating wafers using a device having an anode **2**, a separator **8**, a distributor **21** and a wafer **1** (fig. 3). The separator **8** is porous to ensure even distribution of the solution of the entire wafer; the distributor is used to determine the distribution of solution impinging upon the wafer **1** (col. 6, lines 7-12 and 50-59). In other words, the

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separator **8** is used to control the concentration and the distributor is used to control the overall flow of the solution as it contacts the wafer.

Regarding claims 1, 7, 20 and 57, Edelstein discloses a baffle to modulate the cross-sectional distribution of flow rate in electrodeposition apparatuses. The baffle (mask) is comprised of two non-conducting plates **10, 12** having a plurality of holes **14, 16** that control the cross-sectional flow of the electrolyte by rotating the plates **10, 12** in relation to one another (fig. 1 and 3A-3C). Controlling the cross-sectional flow distribution of the electrolyte allows for the cross-sectional thickness of the deposited layer to be controlled according to the placement and orientation of the holes (fig. 8, 10 and 12).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the shield in the plating apparatus of Stone to use a baffle as taught by Edelstein because the baffle allows the cross-sectional flow distribution of the electrolyte to be controlled, which regulates the cross-sectional thickness of the deposited layer. The use of both a flow controller and a concentration controller would have been obvious to one skilled in the art because Jorne et al. teach the use of both types of controlling devices to allow the control the concentration of the solution and the flow of the solution contacting the wafer.

Regarding claims 5, 6, 12, 25, 33, 36, 39, 40 and 43, Stone discloses, "the power may be provided from any voltage source" (col. 6, lines 55-62). It would have been obvious to one having ordinary skill in the art at the time the invention was made to

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have modified the power source of Stone to use separate power sources or common power sources because Stone teaches that "any voltage source" can be used and the selection of a power source is dependent on the desired result of the system.

Regarding the intended use of the apparatus, i.e., electrodepositing or electroetching as recited in claims 57 and 74, the same apparatus can be used for both processes. To switch from electrodepositing to electroetching, the polarity of the cathode and anode is switched.

16. Claims 2 and 63-66 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stone (U.S. Pat. No. 6,132,583) in view of Edelstein (U.S. Pat. No. 6,106,687) and Jorne et al. (U.S. Pat. No. 6,132,587), as applied above to 1, 4-9, 12, 19-25, 27, 32-45, 57-61 and 68-74, and further in view of Geels (U.S. Pat. No. 4,643,816).

Stone, Edelstein and Jorne et al. describe a plating apparatus having the limitations recited in claims 1, 4-9, 12, 19-25, 27, 32-45, 57-61 and 68-74 of the instant invention, as explained above in section 15.

The apparatus described by Stone, Edelstein and Jorne et al. differs from the instant invention because they do not disclose the conductive mesh attached to the surface of the mask.

Geels discloses a plating apparatus comprising a shroud (mask) **20** having conductive elements **35, 35'** disposed at the ends of the shroud **20** (fig. 1; col. 3, lines

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39-57). The conductive elements **35, 35'** comprise screens of electrically conductive material (col. 3, lines 46-50). The screens **35, 35'** are attached at the end of the shroud **20** to "[provide] a surface over which the electrical potential is substantially uniform, making the potential difference between points on the cathode-workpiece and points on the [screen] as uniform as possible" making the current more uniform (col. 3, lines 50-57).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the conductive mesh in the apparatus described by Stone, Edelstein and Jorne et al. to affix the conductive mesh directly to the mask as taught by Geels because affixing the mesh directly to the mask provides a more uniform potential, resulting in a more uniform coating.

17. Claims 15-18 and 28-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stone (U.S. Pat. No. 6,132,583) in view of Edelstein (U.S. Pat. No. 6,106,687) and Jorne et al. (U.S. Pat. No. 6,132,587), as applied above to 1, 4-9, 12, 19-25, 27, 32-45, 57-61 and 68-74, and further in view of Tzanavaras et al. (U.S. Pat. No. 5,421,987), Uzoh (U.S. Pat. No. 6,071,388) and Hanson et al. (U.S. Pat. No. 6,139,703).

Stone, Edelstein and Jorne et al. describe a plating apparatus having the limitations recited in claims 1, 4-9, 12, 19-25, 27, 32-45, 57-61 and 68-74 of the instant invention, as explained above in section 15.

The apparatus described by Stone, Edelstein and Jorne et al. differs from the instant invention because they do not disclose the following:

- a. One of the isolated sections of the conductive element circumferentially surrounds another of the electrically isolated sections, as recited in claims 15 and 28;
- b. The electrically isolated sections of the conductive element are irregularly shaped, as recited in claims 16 and 29;
- c. One of the electrically isolated sections of the conductive element is ring-shaped, as recited in claims 17 and 30; and
- d. The other of the electrically isolated sections is disc-shaped, as recited in claims 18 and 31.

Regarding claims 15-18 and 28-31, Tzanavaras et al. disclose a plating apparatus comprising bias rings **40** and collimating screens (masks) **34** to control the thickness and uniformity of the deposited layer (col. 5, line 46 to col. 6, line 2; col. 6, lines 52-62). The bias rings **40** are designed to "divert excessive current density away from [the edges and corners of the substrate]" (col. 5, lines 61-67). For square substrates **42**, bias ring **40A** has an irregular shape; for circular substrates **42**, bias ring **40B** is ring-shaped (fig. 2(a) and 2(b)).

Uzoh teaches the use of similar rings **40** that act as auxiliary electrodes to control the deposition around the edges of the workpiece **16** (col. 5, lines 23-45). The auxiliary

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electrodes **40** are made of conductive mesh and can be placed coplanar with the workpiece **16** (as shown in Tzanavaras et al.) or the auxiliary electrode **40** may be "non-coplanar as may be required for a particular electroplating operation" (col. 6, lines 48-63).

Hanson et al. teach the use of a plurality of auxiliary electrodes **130**, wherein each segment **130** has a separately controlled voltage to control the deposited layer (fig. 2; col. 4, lines 3-27). Having a plurality of individually controllable segments allows the deposition to be more precisely controlled.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the conductive mesh screen in the apparatus described by Stone, Edelstein and Jorne et al. to use a bias ring or auxiliary electrode as taught by Tzanavaras et al. and Uzoh because the bias ring/auxiliary electrode enables excess current to be diverted away from the edges and corners of the substrates for different sized substrates. Furthermore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have used a mesh screen as taught by Uzoh because using mesh allows the auxiliary electrode to be positioned coplanar or non-coplanar to the substrate because the mesh permits the flow of electrolyte through its openings.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the conductive elements in the apparatus described by Stone, Edelstein and Jorne et al. to be irregularly shaped, ring-shaped or

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disc-shaped as disclosed by Tzanavaras et al. because Tzanavaras et al. teach that the shape of the bias ring should be designed such that the current density is uniform for the substrate, which requires irregular shapes for polygon-shaped substrates and disc or ring shapes for circular and rounded substrates.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the conductive elements in the apparatus described by Stone, Edelstein and Jorne et al. to use a conductive element comprised of a plurality of cooperative segments as taught by Hanson et al. because a greater number of individually controlled segments allows more precise control of the current density.

Allowable Subject Matter

18. Claims 3 and 26 are allowable over the prior art of record.
19. Claim 13 would be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, set forth in this Office action.
20. The following is a statement of reasons for the indication of allowable subject matter: The prior art of record does not teach or suggest the formation of a conductive mesh sandwiched by two mask layers. This feature of the instant invention allows the current density to be controlled by a single controlling member. The prior art, e.g., Galik (U.S. Pat. No. 4,678,545), discloses separate masks and conductive elements.

Response to Arguments

21. Applicant has not provided arguments regarding the rejections set forth in the Office Action mailed April 30, 2003.

22. The amendments to define first and second surfaces of the mask and the ability to connect to a power source do not distinguish the instant invention claims over the prior art of record.

23. The limitation that "the plurality of openings of the mask defines a plurality of active regions of the conductive [mesh/element]" does not distinguish the instant claims over the prior art of record. The combination of Stone, Edelstein and Jorne et al. teaches a device having a concentration-controlling element (the conductive screen) and a flow-controlling element (mask or baffle). The openings in the mask would define active areas of the conductive element by only allowing certain paths flowing through the conductive element to reach the surface of the substrate. The selected paths define "active areas" because solution flowing from those areas is selectively transmitted through the flow-directing device or mask.


Conclusion

24. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Brian L. Mutschler whose telephone number is (703) 305-0180. The examiner can normally be reached on Monday-Friday from 8:00am to 4:30pm.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (703) 308-3322. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.


NAM NGUYEN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700

blm
October 1, 2003